



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

Explanation of an Optical Deception.

BY D. RITTENHOUSE.

Read March
3, 1780.

SOME experiments were long ago communicated to the Royal Society of London, shewing, that through the double microscope, the surfaces of bodies sometimes appear to be reversed, that is, those parts which are elevated seem depressed, and the contrary. But the cause of this appearance, for any thing I know, remains still to be explained.

In order to produce this effect, no other apparatus is necessary than two convex lenses placed in a tube, at a distance from each other nearly equal to the sum of their focal distances. Through these glasses, objects that appear distinctly, always appear inverted; for they are not seen directly, but by means of an image formed either between the two glasses, or between both of them and the eye.

If we look through such glasses at cornishes, picture frames and other mouldings in carpenters work, and some sorts of carved work, those parts which are raised generally appear depressed, and those parts which are depressed appear raised. But a very ready object, and which succeeds as well as any thing I know of, is a brick pavement; whether it be a chimney-hearth, or pavement out of doors. Viewed through the tube above described, every little cavity in the bricks, and the chinks between them, almost always appear to be so many elevations above the surface of the bricks.

When I considered this odd appearance, the first probable cause that offered was, that those parts of the object which are sunk, and farthest from the eye, might have their correspondent parts of the image formed by the glasses nearest to the eye, and therefore would appear raised.

But

But this is not the case; for those parts which are farthest from the eye in the object, will always be farthest from the eye in the image, and often in a much greater proportion. After some time I concluded it to be a necessary consequence of the apparent inversion of the object; and many things tended to confirm me in this opinion, before I made the experiments which seem perfectly decisive.

It has often been matter of surprize to me, when viewing the moon through a good telescope, in company with persons not accustomed to such observations, that whilst the cavities and eminences of the moon's surface appeared to me marked out with the utmost certainty by their light and shades, my companions generally conceived it to be a plain surface of various degrees of brightness. The reason I suppose to be this; the astronomer knows from the moon's situation with respect to the sun, and even from the figure of its enlightened part, precisely in what direction the light falls on its surface, and therefore judges rightly of its hills and vallies, from their different degrees of light, according to those rules which are imperceptibly formed in the mind, and confirmed by long experience. But a person unacquainted with astronomy knows nothing of the direction of the sun's light on the moon, nor does he attend to the moon's globular figure, and is besides, perhaps, possessed with a notion of its being self-luminous; no wonder then that the same object has a very different effect on his imagination. It seems to be those rules of judging, which we begin to form in our earliest infancy, which we set aside, re-establish, alter, correct and confirm, and at length rely on with the utmost confidence, even without knowing that we do so, or that we have any such rules: It is these rules, of such infinite general use to us, that sometimes mislead us on new and extraordinary occasions, and particularly in the case now before us. A person entering into a room perceives, at a single glance, whence the light comes which illuminates the objects before

fore him ; and that without remaining conscious for a moment that he has attended to this circumstance : But the effect remains, and will influence his judgment. If on looking at a brick hearth he perceives that those lines which divide the bricks have a dark shade on that side opposite to the light, and a bright streak on the contrary side next to the light, he must at the same time perceive that they have the property which he has constantly observed in ridges, not in furrows. And since the appearance of the hearth will be such, through the glasses, in consequence of their inverting the situation of its several parts, with respect to the light, the observer will instantly pronounce the chinks between the bricks, and every little cavity in them, to be so many perfect elevations above the common surface, nor can any effort of the mind correct the imagination or alter the appearance.

Though I was well satisfied of the truth of this explanation, I resolved nevertheless to bring it to the test of experiment, which I did in the following manner.

In order to give my experiment fair play, I shut all the windows of my chamber excepting one directly opposite to the chimney. I then took the tube, with two convex glasses, and looking through it at the hearth, all the bricks appeared depressed and the clefts between them elevated, as usual. I then placed a looking-glass against the chimney back, so that it reflected the light from the window upon the hearth, and set up a small board before the hearth to intercept the direct light of the window from it. Then looking at the hearth through the glasses, I was much pleased to find it appear in its natural state, with the bricks elevated. I then sat down on a chair at the edge of the hearth, and looking through the tube which I held to my eye with one hand, whilst with the other I moved the board so as to make it sometimes intercept the direct light of the window, and at other times the reflected light of the looking-glass, I constantly found that when the hearth

was.

was illuminated by reflected light, it appeared in its natural state, and when illuminated by the direct light, in its unnatural state; for so I call it when the bricks appear depressed and the chinks between them elevated.

I then considered that since the hearth appeared in its natural state by reflected light, and in its unnatural state by direct light, only in consequence of the inverting property of the glasses, the appearance ought to be directly the contrary when it was viewed with the naked eye. And accordingly I found, upon taking out both of the glasses, and looking through the open tube, that the hearth appeared as perfectly, and as constantly in its unnatural state by reflected light, and in its natural state by direct light, as it had before done the reverse through the glasses. But it must be observed that something like a tube is necessary to confine the sight from other adjoining objects, which not being in the same circumstances would otherwise correct the imagination.

If we look through such a tube and glasses at the hearth or other object, suppose a piece of chocolate, the furrows in it appear so many ridges, on removing the tube they sink into furrows, on applying it they again rise into ridges, and the illusion might perhaps be repeated a thousand times, without the mind being at all able to conceive the object to appear through the tube like what it really is. But if whilst you are looking through the tube, and the object appears in its unnatural state, that is, when its furrows appear ridges, you apply your finger and feel that they really are furrows, the deception vanishes in a moment and the object appears in its natural state. This I at first supposed to arise from the superior confidence which we have in the sense of touching, as knowing by experience that this sense more perfectly represents the figure of bodies than the sight does. But I was, at least in part, mistaken. For if whilst you see the object in its unnatural state, another person puts his finger to the part you are
looking

looking at, the deception vanishes as well as in the former case. The application of a writing pen or pencil will produce the same effect. And, which is very remarkable, after the mind has been undeceived by these means once or twice, it does not readily admit of the imposition again: Though, as I observed before, if it be done by removing the glasses, the deception will return again as often as you please. The truth seems to be, that the mind chuses the least difficulty; and though in consequence of the judgment it has formed concerning the direction of the light, it will submit to such a small imposition as to suppose one piece of chocolate may have ridges where others usually have furrows, when indeed it has not, yet it will not readily endure such a gross one, as to suppose it to have cavities of the figure and colour of a finger or a writing pen. Or perhaps the visible motion attending such application produces the principal effect in convincing the mind that those bodies are really elevated*, and then their shades and modifications of the light, shew in what direction it falls on them; and the mistake of the mind in that particular being rectified, the whole object must assume its natural appearance.

The explanation I have given of this phenomenon will account for an odd circumstance mentioned (I think) by Mr. Short; which once appeared so whimsical to me as neither to merit credit or attention. Mr. Short carefully examined the Cassagrain telescope, and in all probability set it by the side of one of the Gregorian form, in order to determine its comparative merits: He gives the preference to the Gregorian, and mentions as a principal defect of the Cassagrain telescope, that it represents the mountains in the moon as vallies, and the contrary. I doubt not but this,

F

otherwise

* Whilst I was making these experiments, I thought of a carved silver shoe buckle, as a very proper object to prevent a deception of this sort from taking place. But placing it on a brick pavement, and looking at it through the glasses, it nevertheless appeared perfectly depressed. Precisely as if you had taken a buckle and strewn on it a white shining powder, had pressed it into the brick whilst soft, and then removing the buckle, the glittering powder had remained in the impression.

otherwise unaccountable appearance, was occasioned intirely by its inverting the object, for the reasons above given. If it be asked, why then do not the common long refractors, which generally invert, produce the same deception? I answer, very probably they would do so if set beside a Gregorian reflector and the eye applied alternately to the one and to the other*.

N^o III.

Description of the White Mountains in New-Hampshire.

By THE REV. JEREMY BELKNAP OF NEW-HAMPSHIRE.

Read Oct.
15, 1784.

THE white mountains in the northern part of New-Hampshire have, from the earliest settlement of the country, attracted the attention of all sorts of persons. They are undoubtedly the highest lands in New-England, and are discovered in clear weather by vessels coming on the eastern coast, before any other land; but by reason of their bright appearance are frequently mistaken for clouds. They are seen on shore at the distance of sixty or eighty miles on the south and south-east sides, and are said to be plainly visible in the neighbourhood of Quebec. The Indians had a superstitious veneration for them as the habitation of invisible beings, and for this reason never ventured to ascend their summits, and always endeavoured to discourage every person who attempted it. From them, and the captives whom they formerly led to Canada through the pass of these mountains, many fictions have been propagated through the country which have in time swelled to marvellous and incredible stories; particularly,

* The above was written in 1774, when I had no achromatic astronomical telescope in my possession.